Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Controlling pulsatile jet formation number with variable diameter exit nozzle for maximum impulse generation[1] MIKE KRIEG, TYLER THOMAS, KAMRAN MOHSENI, University of Colorado — Both jellyfish and Squid propel themselves by ejecting high momentum vortex rings. A set of vortex ring generating thrusters were developed and tested for application in underwater vehicle propulsion. Vortex rings generated from a steady piston cylinder mechanism have a universal formation time, known as the formation number (Gharib et al. 1998), associated with reaching maximum circulation, where the vortex ring separates from its trailing shear flow. The non-dimensional jet formation time (also called the stroke ratio) plays a key role in the thrust output of the device; since thrusters operating above the formation number re-ingest the trailing jet. A variable diameter exit nozzle was used to increase the formation number of the jet to maximize thrust (which is a technique observed in squid and jellyfish locomotion). Visualization studies confirmed the ability to delay the onset of ring "pinch-off", using a variable nozzle, and the thrust was empirically shown to achieve a higher maximum. Additionally, a fluid slug model which was developed to predict the thrust output was adapted to incorporate a changing nozzle diameter. This model was verified with the empirical thrust data and was again shown to be accurate for stroke ratios below the formation number.

[1]The authors thank ONR for financial support.

Mike Krieg
University of Colorado

Date submitted: 10 Aug 2009 Electronic form version 1.4